

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT STATIONARY SOURCE COMPLIANCE DIVISION PERMIT APPLICATION PROCESSING AND CALCULATIONS	PAGES 7	PAGE 1
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Permit to Construct/Operate (New Construction)

Applicant Eastern Municipal Water District (EMWD) –Perris Valley
Regional Water Reclamation Facility (PVRWRF)

Mailing Address 2270 Trumble Road
P.O. Box 8300
Perris, CA 92572

Equipment Location 1301 Case Road
Perris, CA 92570

Equipment Description
APPLICATION 499897, FACILITY ID 007417

DIGESTER GAS TREATMENT SYSTEM AND FUEL CELL POWER PLANT CONSISTING OF:

1. KNOCKOUT TANK.
2. TWO HYDROGEN SULFIDE REMOVAL VESSELS, APPLIED FILTER TECHNOLOGY, ESC CORPORATION, OR EQUIVALENT, AT LEAST 10'-0" DIA. X 10'-0" H., EACH WITH AT LEAST 25,000 POUNDS MEDIA.
3. PARTICULATE FILTER.
4. PRE-COOLER WITH DEMISTER.
5. ONE COMPRESSOR, 325 SCFM, ELECTRICALLY DRIVEN.
6. GAS PRE-COOLER AND COOLER WITH DEMISTER.
7. GAS RE-HEATER.
8. TWO SILOXANE REMOVAL VESSELS, APPLIED FILTER TECHNOLOGY, ESC CORPORATION, OR EQUIVALENT, AT LEAST 4'-0" DIA. X 8'-0" H. BED DEPTH, EACH CONTAINING AT LEAST 2,500 POUNDS MEDIA.
9. PARTICULATE FILTER.
10. TWO FUEL CELLS, FUEL-CELL ENERGY, MODEL DFC300MA, 600 KW TOTAL MAXIMUM POWER OUTPUT.
11. TWO HEAT RECOVERY UNITS, EACH WITH AN ELECTRIC HEATER.

Background/Process Description

The above application was submitted on June 24, 2009 for New Construction, Permit to Construct/Operate for a digester gas treatment system and molten carbonate fuel cell power plant.

The digester gas treatment system is required to remove sulfur compounds and siloxanes from the biogas generated in the digester before the cleaned gas is consumed by a molten carbonate fuel cell. The sulfur

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in the digester gas at EMWD-San Jacinto has a TRS as H₂S concentration of 1.7 ppmv. Although, similar facilities such as EMWD-Moreno Valley has a TRS as H₂S concentration of 201 ppmv. The digester gas analysis was sampled and analyzed on 8/18/2009 and 8/19/2009 respectively. The concentration of mercaptans is expected to be below detection limits. The system is designed to treat a maximum of 325 scfm of digester gas.

The first step in the treatment process is sulfur removal. H₂S is removed by passing low pressure digester gas (LPDG) through a vessel filled with activated carbon impregnated with Fe₂O₃ (iron sponge). Each H₂S removal vessel contains approximately 25,000 pounds of media with a removal efficiency estimated at 95%, which enables the system to reduce the concentration of H₂S in the treated gas to less than 3 ppmv and below the maximum tolerance of 6.1 ppmv specified for the fuel cell. Then a particulate filter is used to remove any entrained particles from the H₂S adsorbent.

The LPDG moves through the “hot” side of an air-to-glycol/water heat exchanger where it is pre-cooled to 60 degrees Fahrenheit and condensate is removed by an integral demister before the flow is directed to a compressor. Heat is rejected to the chiller piping loop. The digester gas is compressed to 35 psig medium pressure digester gas (MPDG) at 200 degrees Fahrenheit. After the compressor the MPDG moves through the “hot” side of the air-to-air heat exchanger where it is pre-cooled to 160 degrees Fahrenheit. Heat is rejected to the MPDG loop later in process. The pre-cooled MPDG moves through the “hot” side of the air-to-glycol/water heat exchanger where it is cooled to 40 degrees Fahrenheit and condensate is removed by a demister. Heat is rejected to the chiller piping loop. The MPDG moves through the “cold” side of the air-to-air heat exchanger where it is reheated to 80 degrees Fahrenheit. The MPDG is then sent to the siloxane removal vessels.

Each siloxane removal vessel contains 2,500 pounds of specially treated graphite coated filters to remove siloxanes and trace toxic air contaminants (TACs). Based on fuel analysis of the raw digester gas and permit conditions, the TAC concentrations are as follows: benzene < 110 ppb, chlorobenzene < 7 ppb, perchloroethylene < 7 ppb, dichlorobenzene < 294 ppb, ethyl benzene < 45 ppb, toluene < 716 ppb, trichloroethylene < 3ppb, chloroform < 38 ppb, and xylenes < 200 ppb. Although the gas flow is split between the two vessels, each has the capacity to handle all gas while maintenance is conducted on the second vessel.

After the gas exits the siloxane removal vessels, a particulate filter is used to prevent entrainment of the adsorbent in the gas stream. Then the treated digester gas stream leaves the gas treatment system at 80 degrees Fahrenheit and 25 psig as a suitable fuel for the fuel cell because the contaminant levels are reduced to less than 3 ppmv H₂S, and 0.1 ppmv siloxanes. The fuel cell can tolerate a maximum H₂S and siloxane concentration of 6.1 ppmv.

The treated digester gas is sent to the fuel cell system where the fuel is converted to hydrogen which is electrochemically reacted with oxygen to produce electricity and heat. The fuel cell system consists of two molten carbonate type 300 kW fuel cells which have an operating temperature of 1200 degrees F. This type of fuel cell uses a preconverter to convert non-methane hydrocarbons to methane, and an internal reformer to convert the fuel from methane to hydrogen before the hydrogen is reacted electrochemically to water. In addition, small quantities of NO_x, SO_x, CO, and VOC are also generated.

The exhaust from each fuel cell is passed through a heat exchanger before the exhaust gas is vented to the atmosphere through separate stacks. The exhaust air is vented at an exit temperature of approximately 700 degrees F. The operating schedule of the equipment is 24 hours per day, 7 days/week, 52 weeks/year. The only time the digester gas treatment system or fuel cell system will not be in operation is during

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maintenance or breakdown repairs. When the digester gas treatment system is not operating, the fuel cells will continue operation with natural gas.

The facility is a municipal water district which accepts and treats municipal sewage and produces recycled water for a 120 square mile area in Perris, Sun City, Romoland, and part of Moreno Valley. Eastern Municipal Water District-Perris Valley Regional Water Reclamation Facility (EMWD-PVRWRF) currently consists of two separate wastewater treatment facilities, a 3 MGD and 8 MGD facility. The 3 MGD facility was originally built in 1982 as a 1 MGD until the capacity was optimized to 3 MGD in 1991. The 8 MGD treatment facility has been in operation since 1994. EMWD is in the process of installing a new plant (Plant 3) and modifying the other two plants. Plant expansion is planned for 24.2 MGD. There is no school within 1000 feet of emission source. NOV #P49737 was issued March 31, 2009 for operating a stationary internal combustion engine in a manner that exceeds the emission concentration limits for NOx.

Emission Calculations

The emission factors in lb/MWh and ppmv are based on the manufacturer's emission specifications of the equipment. The bolded lb/hr emissions are considered the maximum potential emission for this equipment and used for NSR. R1 = R2. NOx is measured as NO2 and SOx is measured as SO2.

600 kW	100% Load		75% DG		50% DG	
Pollutant	Lb/MWh	Lb/hr	Lb/MWh	Lb/hr	Lb/MWh	Lb/hr
CO	0.07	0.042	0.01	0.006	0.00	0
NOx	0.00	0	0.00	0	0.01	0.006
PM10	-	-	-	-	-	-
VOC	0.02	0.012	0.01	0.006	0.01	0.006
SOx	0.001	0.0006	0.001	0.0006	0.001	0.0006

600 kW	100% Load		75% DG		50% DG	
Pollutant	ppmv	Lb/hr	ppmv	Lb/hr	ppmv	Lb/hr
CO	4.4	0.03	1.0	0.01	0.2	0.0013
NOx	0.14	0.0015	0.15	0.0016	0.23	0.0024
PM10	-	-	-	-	-	-
VOC	3.9	0.08	1.7	0.03	1.2	0.02
SOx	-	-	-	-	-	-

The pound per hour emissions listed in the above table are based on the following calculation:
 $\text{ppmv} \times 719^* \text{ dscfm/fuel cell} \times 2 \text{ fuel cells} \times 60 \text{ min/hr} \times \text{lb-mole}/379 \times 10^6 \text{ ft}^3 \times \text{MW lbs/lb-mole}$
 * 719 dscfm is based on the preliminary results of a source test conducted on similar fuel cell under Permit G2337, A/N 473542 located at EMWD-Moreno Valley.

Please note that a similar system (3 fuel cells, with a total of 900 kW maximum power) located at Eastern Municipal Water District in Moreno Valley has been permitted and source tested under Permit G2337, A/N 473542. The source tests indicated that there was a net increase in benzene emissions, which negates the notion that fuel cells emit very low emissions. The previous source test results were questioned because the low level of TAC in the fuel cell exhaust is very difficult to measure without contamination, and any error could translate into perceived net increase in exhaust mass emissions. Consequently, SCAQMD conducted two tests. The first on a 1 MW fuel cell operated by Riverside City, Facility ID 9961 and the second on a 900 kW fuel cell operated by EMWD, Facility ID 13088.

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The first test shows that emissions of TAC from the 1 MW fuel cell are all less than 0.1 ppb, when operated on digester gas. The preliminary results from the 900 kW fuel cell shows the TAC from one of the three identical fuel cells were less than 0.1 ppb. Only one of the fuel cells was tested since the quantity of digester gas was only sufficient for one fuel cell. A simultaneous sample was taken at the raw digester gas inlet and treated digester gas outlet.

The source test for criteria pollutants at the Riverside City site indicated emissions were less than detection limits of < 5ppmv for NO_x, <1ppmv for CO. VOC emissions were less than 8.7 ppmv and SO_x emissions were less than 0.011 ppmv.

The preliminary data for the EMWD site indicates the stack flow rate was 719 dscfm during the EMWD source test. The NO_x emissions were less than the detection of 1ppmv and CO emissions were less than the detection limit of 1 ppmv. Uncorrected VOC emissions were less than 4.9 ppmv (uncorrected for moisture 15% H₂O) and the mass emission rate was estimated at 0.008 lbs/hr for one cell. For all three fuel cells the estimated VOC emission is 0.02 lbs/hr.

Toxic Risk Analysis

Nearest Residential Receptor Distance:	3318 ft. (1012 m)
Nearest Commercial Receptor Distance:	1312 ft. (400 m)
Stack height:	10.0 ft. (3.05 m)
Stack inner diameter:	8.0 in. (0.20 m)
Rain cap:	Yes
Exhaust flow rate:	719 dscfm x 2 fuel cells = 1438 dscfm 878 acfm x 2 fuel cells = 1756 acfm

Compound	MW (lbs/lbmole)	Outlet concentration (ppmv)	Outlet emission (lb/hr)
Benzene	78.11	0.0001	1.78E-06
Chlorobenzene	112.56	0.0001	2.56E-06
1,4-Dichlorobenzene	147.01	0.0001	3.35E-06
1,1-Dichloroethane	98.96	0.0001	2.25E-06
1,2-Dichloroethane	98.96	0.0001	2.25E-06
Ethylbenzene	106.16	0.0001	2.42E-06
Methylene chloride ¹	84.94	0.0001	1.93E-06
Tetrachloroethylene	165.83	0.0001	3.78E-06
Toluene	92.13	0.0001	2.1E-06
Trichloroethylene	130.40	0.0001	2.97E-06
m/p-Xylene	106.17	0.0001	2.42E-06
o-Xylene	106.18	0.0001	2.42E-06

¹ Exempt compounds that are not considered as VOCs by Rule 102.

The emission rates for the toxic air contaminants (TACs) are based on concentrations from a source test conducted on a fuel cell under A/N 471791, Facility ID 9961 City of Riverside, Regional Water Quality Control Plant. The exhaust flow rate is based on the preliminary results of a source test conducted on the same type of fuel cell as this application under Permit G2337, A/N 473542, Facility ID 13088 EMWD-Moreno Valley.

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Tier III analysis was used since the exhaust stacks have a rain cap. Tier III risk analysis was based on the emission rates listed in the above table. The MICR values are determined to be 1.06×10^{-10} for residential and 6.94×10^{-11} for commercial receptors. HIA and HIC are less than 1. Cancer Burden was less than 0.5.

Emissions Summary

Emission Total (based on NSR lbs/day values)

A/N 499897 (DG Treatment System and Fuel Cell Power Plant)

CO	= 0.04 lbs/hr	= 0.97 lbs/day
NOx	= 0.01 lbs/hr	= 0.24 lbs/day
PM10	= 0 lbs/hr	= 0 lbs/day
ROG	= 0.08 lbs/hr	= 1.95 lbs/day
SOx	= 0 lbs/hr	= 0 lbs/day

A/N 503372 (ICE (>500HP) Em Stat NG & LPG)

CO	= 2.60 lbs/hr	= 0.36 lbs/day
NOx	= 0.65 lbs/hr	= 0.09 lbs/day
PM10	= 0.17 lbs/hr	= 0.02 lbs/day
ROG	= 0.65 lbs/hr	= 0.09 lbs/day
SOx	= 0.01 lbs/hr	= 0 lbs/day

A/N 505538 (Boiler (5-20 mmBtu.hr) Other Fuel)

CO	= 0.75 lbs/hr	= 18.25 lbs/day
NOx	= 0.37 lbs/hr	= 9.00 lbs/day
PM10	= 0.06 lbs/hr	= 1.46 lbs/day
ROG	= 0.05 lbs/hr	= 1.22 lbs/day
SOx	= 0.29 lbs/hr	= 7.06 lbs/day

Total of all applications (499897, 503372, and 505538)

CO	= 3.39 lbs/hr	= 19.58 lbs/day
NOx	= 1.03 lbs/hr	= 9.33 lbs/day
PM10	= 0.23 lbs/hr	= 1.48 lbs/day
ROG	= 0.78 lbs/hr	= 3.26 lbs/day
SOx	= 0.30 lbs/hr	= 7.06 lbs/day

Previous Emission Total (based on NSR lbs/day values)

A/N 409351 (ICE (>500HP) N-Em Stat NG)

CO	= 2.60 lbs/hr	= 63 lbs/day
NOx	= 0.65 lbs/hr	= 16 lbs/day
PM10	= 0.16 lbs/hr	= 4 lbs/day
ROG	= 0.65 lbs/hr	= 16 lbs/day
SOx	= 0.01 lbs/hr	= 0 lbs/day

Total Emission Increase (based on NSR lbs/day values)

CO	= 0.79 lbs/hr	= -43.42 lbs/day
NOx	= 0.38 lbs/hr	= -6.67 lbs/day
PM10	= 0.07 lbs/hr	= -2.52 lbs/day

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ROG = 0.13 lbs/hr = -12.74 lbs/day
 SOx = 0.01 lbs/hr = 7.06 lbs/day

Rules Evaluation

- Rule 212: Rule 212 (c)(1)- There is no school within 1000 feet of the facility.
 Rule 212 (c)(2)- On-site emission increases does not exceed the following:
 Volatile Organic Compounds 30 lbs/day
 Nitrogen Oxides 40 lbs/day
 PM10 30 lbs/day
 Sulfur Dioxide 60 lbs/day
 Carbon Monoxide 220 lbs/day
 Lead 3 lbs/day
 Rule 212(c)(3)(A)(i)- MICR is below 1 in a million.
Public Notice is not required.
- Rule 401: Visible Emissions
 No violations are expected, limits are listed under Rule 401(b)(1).
- Rule 402: Nuisance
 Nuisance is not expected with proper operation, monitoring and maintenance. No complaints have been received in the last four years against the facility. Based on previous operation of the facility for the last two years, compliance is expected.
- Rule 407: Liquid and Gaseous Air Contaminants
 Rule 407(a)(1)- CO shall not exceed 2000 ppmvd, averaged over 15 consecutive minutes.
 Rule 407(a)(1)- Sulfur compounds which would exist as liquid or gas at standard conditions, shall not exceed 500 ppmv, calculated as SO₂ and averaged over 15 consecutive minutes.
- Rule 431.1: Sulfur Content of Gaseous Fuels
 Rule 431.1(c)(1)- Natural gas containing sulfur compounds as H₂S ≤ 16ppmv.
 Rule 431.1(g)(8)- Any facility which emits less than 5 pounds per day total sulfur compounds, calculated as H₂S from the burning of gaseous fuels other than natural gas (not applicable to (c)(1)).
 Compliance is expected.
- Rule 53A: Riverside County – Specific Contaminants (Contained in Addendum to Reg IV)
 Rule 53(a)- Sulfur compound emission, as SO₂ 50,000 ppmv. Compliance can be expected based on other similar category ICE permits issued in SCAQMD.
 Rule 53(b)- Fluorine compounds shall be controlled to the maximum degree technically feasible. No fluorine potential emission from this equipment. Compliance is expected.
- Reg XIII: Rule 1303(a)- Although, maximum potential emissions (VOC) from this equipment are greater than 1 pound per day, currently there are no BACT requirements for this equipment.

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Rule 1303(b)(1)- Modeling for VOC and SO_x is not required (1303 Appendix A). NO_x, CO and PM₁₀ are less than the allowable emissions in Table A-1, no further analysis is required (1303 Appendix A).

Rule 1303(b)(2)- Offsets are not required; the facility is a POTW and is an essential public service.

Rule 1401: Toxic Air Contaminants

Rule 1401(d)(1)(A)- MICR less than 1.0×10^{-6} . The increase in Risk is estimated to be 1.06×10^{-10} for residential and 6.94×10^{-11} for commercial receptors

Rule 1401(d)(1)(C)- Cancer burden is less than 0.5.

Rule 1401(d)(2) and Rule 1401(d)(3)- HIC and HIA values are estimated to be less than 1 respectively.

Compliance is expected.

Rule 1401.1: Rule 1401.1(b)- Equipment is exempt since it is located at an existing facility.

Reg. XXX: The installation of the digester gas treatment system and fuel cell power plant, change of conditions for the stationary ICE, and installation of the digester gas and natural gas boiler is considered a Title V De Minimis Significant permit revision under Rule 3000(b)(6), since the cumulative emission increases of non-RECLAIM pollutants or HAPs do not exceed the emissions in Table 5-4 of the Draft Title V TDG March 2005 and does not result in new or additional NSPS or NESHAP requirements and will be subject to an EPA review (Rule 3003(j)). A public notice is not required.
Compliance is expected.

Conclusions & Recommendations

The equipment is in compliance with the Rules and Regulations of the SCAQMD. A Permit to Construct/Operate is recommended for application 499897. For Permit Conditions please see Sample Permit. A revised Title V permit is recommended after EPA review.